BIO-DYNAMICS

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HOW MUCH COMPOST SHOULD WE USE?

EHRENFRIED E. PFEIFFER

The question of the rate of application per acre is one that is frequently asked. More recently, another has come up: Can we use too much? Here is our advice. Make all the compost you can in your garden and on your farm, using all available wastes, and it will never be too much. In fact, in many cases it will not be enough. If you have to buy compost, manure or fertilizers made from organic wastes, buy with reason and with knowledge, not at random. The term *compost* as used in this article includes well-rotted manure—*not fresh manure.*

Maximum applications of 150 tons per acre have been seen, but on the average 5 to 20 tons per acre are more usual. Of dehydrated, skillfully manufactured and concentrated composts, as little as one ton per acre may be sufficient. The range is wide so common sense and some basic knowledge are necessary. When using inorganic fertilizers one is guided by their formulas and the apparent needs of the plants to be fertilized. While the chemical formula of the inorganic fertilizer gives a lead as to its rate of application, the chemical formula of a compost does not entirely answer this question, although it can help in determining its usefulness. The customary NPK (nitrogen, phosphate, potash) analysis indicates only a small part of the total value of composts.

The chemical farmer and gardener knows the NPK and lime requirements of his crops. More recently he also considers (or should consider) magnesium and a long list of trace minerals. Only now is he beginning to appreciate the value of organic matter. He knows the behavior of heavy clay soils and light sandy soils. In practice he applies very little of the existing information about the availability of minerals. It is true that he buys available fertilizer elements. State laws prescribe the use of formulas on fertilizers with regard to soluble inorganic nitrogen such as sulphate or nitrate of ammonium, and organic nitrogen (urea, for instance); available phosphates (such as superphosphate) as against total or unavailable phosphates (rock phosphates, for example); water soluble potash or available potash, to mention the big three (N P K). Lime is used in accordance with the degree of acidity of a field or its calcium deficiency.

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Manufactured (Dry): From	2	2	1	20-40	below 20	40	40	20	1	5	40	40	20	fertile, medium to heavy	moderate to light
Manufactured, Enriched (Dry): from Garbage, Swill, and High-N Wastes	3	3	2	20	below 20	60	60	40	1	5	60	60	40	all	moderate to heavy

Table II. Formula and Application Relationship: For Orientation, And For Individual Application of Composts

Formula in Percent			Application Rates in Tons/Acre—Plant Foods in Pounds/Acre																
			At 1 Ton			At 2 Tons			At 3 Tons			At 5 Tons			At 10 Tons			At 15 Tons		
N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
0.5	0.5	0.5	10	10	10	20	20	20	30	30	30	50	50	50	100	100	100	150	150	150
1	1	1	20	20	20	40	40	40	60	60	60	100	100	100	200	200	200	300	300	300
1	2	1	20	40	20	40	80	40	60	120	60	100	200	100	200	400	200	higher amounts		
2	2	1	40	40	20	80	80	40	120	120	60	200	200	100	400	400	200	are not needed		
2	2	2	40	40	40	80	80	80	120	120	120	200	200	200	400	400	400			
2	3	1	40	60	20	80	120	40	120	180	60	200	300	120	higher amts.					
3	3	2	60	60	40	120	120	80	180	180	120	300	300	200	not needed					
3	4	2	60	80	40	120	160	80	180	240	120	higher amts. not needed								

Decrease application and increase formula for fertile soils above 2% organic matter, and for heavy feeders and more frequent applications. ▼

▲ Increase application and decrease formula on light or sandy soils, and soils below 2% organic matter, and for light feeders, and less frequent applications.

Fertile Soils ◄——— Decrease application with increasing formulas on fertile soils

Increase application with decreasing formulas on lighter and poor soils ———► Light Soils

For the best soils and lighter feeders in moderate and Northern moist climates reduce application and formula.

For poorest soils, heavy feeders and in Southern dry, hot climates increase application 1 step.

Using cover and green manure crops and mulching brings you 1 step lower in formula or application.

For fruit trees figure out how many trees to the acre, divide the NPK requirements per acre by the number of trees and you will find how much to give per tree, according to the requirement of the tree.

Table I. Average Compost Application As A Guide to Practice

Type of Compost	Percentage Analysis of Compost					Lbs. Plant Foods Per Ton Compost			Suggested Application Rate in Tons Per Acre	Suggested Application Rate in Lbs. Per 100 Sq. Ft.	Lbs. Plant Foods Per Acre At Given Rates			Suggested for	
	N	P	K	O.M.	Moist.	N	P	K			N	P	K	Soil Type	Crop Demand
Homemade Garden or Farm: from Leaves, Weeds, Plant Waste	0.5	0.5	0.5	below 20	above 50	10	10	10	15	75	150	150	150	light to medium	heavy
The Same and Wet Farmyard Manure	0.5	0.5	0.5	below 20	above 50	10	10	10	10	50	100	100	100	medium to heavy	heavy & moderate
The Same	0.5	0.5	0.5	below 20	above 50	10	10	10	5	25	50	50	50	rich soils	light or top dressing
Homemade Garden or Farm: from Kitchen Waste, Plant Refuse	1	1	1	below 20	above 50	20	20	20	10	50	200	200	200	all, as basic fertilizer	heavy & moderate
The Same	1	1	1	below 20	above 50	20	20	20	5	25	100	100	100	all, in good condition	moderate
The Same	1	2	1	below 20	above 50	20	40	20	10	50	200	400	200	all	heavy
The Same	1	2	1	below 20	above 50	20	40	20	5	25	100	200	100	fertile	moderate
Best Homemade Compost: Containing Swill or N-rich Wastes	2	2	2	20-30	about 50	40	40	40	5	25	200	200	200	all	moderate to heavy
Composted Farmyard Manure (Dry): Straight or Mixed	2	2	2	20-40	below 20	40	40	40	5	25	200	200	200	all	heavy
The Same	2	2	2	20-40	below 20	40	40	40	2.5	12.5	100	100	100	fertile	moderate
Composted Poultry Manure (Wet)	1.5	2.5	1.5	20-40	above 50	30	50	30	5	25	150	250	150	all	moderate to heavy
Composted Poultry Manure (Dry)	2.5	2.5	2.5	20-40	below 20	50	50	50	5	25	250	250	250	all, in poor condition	heavy
Moanufactured (Dry): From Garbage and Industrial Wastes	1	2	1	20-40	below 20	20	40	20	3	15	60	120	60	all, fertile	moderate to light
Manufactured (Dry): From	2	2	1	20-40	below 20	40	40	20	1	5	40	40	20	fertile, medium	moderate to light
Manufactured, Enriched (Dry):														to heavy	

Rarely, if ever, does the farmer or gardener ask: Do these fertilizers remain available in the soil? Are they efficiently used or wasted. In recent years, there has come to light a fact which can be of utmost importance: mineral plant food elements can be *tied down* in a soil. Lime can be applied by the ton year after year but the pasture or hayfield remains acid. It has been tied down and carried into the deeper layers of the soil where it cannot be reached by the plant roots. Actually such fields have been over-limed. In certain soils available phosphates can become unavailable almost immediately after application. Thus in alkaline soils they may become altogether unavailable right away, and in acid soils only a fraction of the phosphate may remain useful for the immediate crop, usually between 2 and 10 per cent, at best 20 per cent. The bulk of the phosphate fertilizer is tied down, has become unavailable. Lucky the farmer whose soil conditions are such that the phosphate fertilizer, due to microlife and cultivation, can be made available in successive years. Unlucky the farmer whose soil stores the phosphate or transports it to lower levels inaccessible to roots or even lets it wash out (chemical erosion vertically downward). Such soils remind one of the old story of a thirsty horse who is tied to a fountain, but with so short a halter that he cannot reach the water. The fountain can be ever running, the farmer will buy more and more; in fact, he finds that he needs more and more every year to hold his yield level. The term "water soluble potash", prescribed by some State laws on the fertilizer bag, is especially deceptive. Water soluble means what it says. It is that part of potash which runs away with the water (rain or irrigation). It is also most easily absorbed by plants, too easily, in fact, and then leads to luxury consumption causing disturbances in the metabolism of the plants and the animals which eat them. Besides all this there are the problems of the inter-relationship of trace mineral availability or unavailability and the other fertilizer elements. One example is the adverse relationship between boron and lime.

Composts behave differently and cannot be judged entirely by their NPK formula. Nitrogen in compost is mostly organic nitrogen. Much less nitrates are present and very little ammonia should be present. Phosphates and potash are also present, but in forms which do not show up through the prescribed analytical procedures for determining availability or water solubility. At best, following customary analytical methods one can determine the total amount of nitrogen, phosphate and potash. But these methods do not take into account the fact that—due

to the microlife in the soil and in the compost—these compounds are slowly and gradually made available in soil when compost is applied.

Experience has shown that low nitrogen formulas (1 to 2%) in compost produced as good results as the application of high nitrogen fertilizer formulas (6-16%) with one important difference. Highly soluble fertilizer elements produce a rapid but not lasting effect while composts produce a slower but longer lasting effect. The effects of highly soluble and available fertilizer elements make the best showing during the first three to six weeks after application. The elements in composts last for three to six months with a steady release, and if the soil is rich in organic matter, further beneficial effects can be seen in the second and even in the third year.

Now we come to the most important question. Not all composts are alike, either in formula or in behavior. Here the greatest mistakes have been made in the past by using composts indiscriminately under the far too general heading "compost" or "the organic method". Of fertilizers there are many brands and formulas. There are also many different formulas of compost, maybe even many more than of fertilizers. A grading of composts is absolutely necessary if one wants to use them efficiently. But the intrinsic processes in a living compost and in soils should also be understood in order to arrive at maximum effects. The different types of possible composts must therefore be considered.

We will begin with the *organic matter* content of compost. It is incorrect, as one reads here and there, to say that a compost contains 100% organic matter. It is correct to say that it has been made from organic wastes such as plant (garden) refuse, leaves, garbage, sawdust, animal wastes, manure, etc. These materials are of organic origin because they derive from things which at one time were living organisms. If plastics are used they may be products of organic compounds. But most of these source materials also contain inorganic minerals. A living plant contains 2 to 10% inorganic compounds which upon combustion show up as ashes. Organic materials in strictly chemical terms are combustible and derive from complicated compounds of the chemistry of carbon, nitrogen, hydrogen, and oxygen, sometimes combined with other elements such as sulphur and phosphates as in proteins and their breakdown products; or carbon compounds like sugar, cellulose, hemicellulose; or combinations with calcium, magnesium and other mineral elements. A compost is a

breakdown product of all these materials. Microorganisms have used part or all of these breakdown products and "digested" them, building up new compounds which in turn again break down. It is of the utmost significance for the fertilizer value of composts to what degree these breakdowns, new syntheses, secondary breakdowns, have taken place. The final, end products of all breakdown processes are: carbon dioxide, simple nitrogen compounds such as N2, NO2, NO3, NH3, and water; all of which can be lost in one way or another. Simple mineral compounds result such as calcium, magnesium, other nitrates, ammonia salts, carbonates as well as silicates and aluminates as they may happen to be present in the source materials. The organic matter content of a compost therefore can vary greatly.

Average farm and garden made composts contain a sizable amount of earth. The organic matter content is therefore low. In fact most of these composts range between 12 and 20% organic matter content, a percentage of 20 to 30 is rarely if ever found. Many piles, especially if they are earthy, old and well-rotted are nearer the 12% level, and piles with less, even as low as 6 to 9%, have been frequently encountered in our analytical work. These are still called compost because of their origin and the way in which they have been treated, but actually they have become soil—a rich soil, though, rich in organic matter. Here a mineralization process has taken place and most of the carbon has vanished in the form of carbon dioxide. It is evident that such mineralized composts behave entirely differently when applied to soils than others with a high organic matter content. It is an illusion for the gardener to think that he can appreciably increase the organic matter in his soils by using low organic matter composts. While they still will be of benefit to the soil structure, improving soil particle agglomeration or aggregation, their main value is in their mineral content whatever it may be. Of these low organic matter composts a considerable amount has to be given per acre if any apparent results are to be obtained.

RULE I: Of earthy, well-rotted, low organic matter composts 10 to 20 tons per acre may be used, or ½ to 1 lb. per square foot, or 500 to 1000 lbs. per 1000 square feet. No harm can be done at such rates. However, the term organic matter only tells us the amount of combustible compounds present but not the degree of breakdown. Crude compost may contain the same amount of organic matter as a well-digested material such as humus. The effect of a raw compost upon soil is quite different from that of a humified compost. It is the skillful and experienced

compost manufacturer's aim to produce a compost with a high organic matter content in a well broken-down state (humified), but not in an extreme state of mineralization. So-called stabilized products of simply broken-down crude organic matter are again entirely different products, even though their formulas may give the same NPK percentage as others. Such products hardly meet the definition *compost*. Higher rates of application than those given in Rule I are not desirable for many reasons, one of these being the increased packing and hardening of the soil due to hauling so many truck loads over the field, not to speak of the cost of the spreading operation.

A word must now be said about the *moisture content*. A homemade garden or farm compost is usually wet and in this state has a moisture content of about 50%; or it may be dry to the touch, and then the moisture will run from 20 to 30%. If it is dusty, it will probably contain less than 15% moisture. A yardstick to help in estimating moisture content and hints on how to acquire it were outlined in an article in BIO-DYNAMICS some time ago. (1) It should be realized that more of a material containing half of its weight in water must be used than of another containing only a quarter of its weight in water. The above given rate of 10 tons/acre applies to fairly dry but not dusty composts, and the rate of 20 tons/acre applies to wet or rather moist composts. A dryer compost contains a higher percentage of minerals than a wet one, one might say that it is a "stronger solution". Analyses of composts should, therefore, not only give the organic matter and mineral content, but also the moisture content. For example, one can calculate the absolute content on a dry basis, but this is not the percentage that is applied in practice.

As far as crop growth and yield are concerned the *nitrogen* content is certainly decisive. We should know the nitrogen content. However, reference must again be made to the moisture content. We will fare much better if we know not only the *percentage* of nitrogen but also how many pounds per acre of nitrogen we are giving at the given rate of application. Most homemade garden and farm composts, manure from horses, cattle, and hogs, have a total nitrogen content of 0.5 to 0.7% at a moisture of 50% and more. Cattle manures have a moisture content of 80%. Poultry manure is the exception and can contain as much as 1.5% total nitrogen at high moisture levels. On a dry basis, the total nitrogen content of all of these will be higher. Dry composts will run from 1 to 2%; dry cattle (steer)

manure may have as much as 2%, poultry manure 2.5 to 3% nitrogen.

Compost or manure of 1% nitrogen contains 20 lbs. of nitrogen per ton no matter what the moisture content is. If one ton of a 1% nitrogen compost is applied to an acre you are applying 20 lbs. of nitrogen. If ten tons are spread you will be giving 200 lbs. per acre. 0.5% nitrogen in a manure or home garden compost means that, at the rate of 10 tons / acre, 100 lbs. of nitrogen are applied, or at the rate of 20 tons/acre 200 lbs. of nitrogen are applied.

Two hundred pounds of nitrogen is the upper limit for most crops. Many crops require less, for instance 60, 80, or 120 lbs. It is evident that much less of a high nitrogen, low moisture compost need be applied per acre than the above-mentioned figure of 10 tons. In fact we have seen good results with the B. D. Starter produced compost when only 1 ton/acre was used. This compost was, of course, dry.

An insufficiently rotted, rather raw compost of low nitrogen content should not be used. Its further decomposition in the soil arrests all nitrogen fixation for a considerable length of time, namely until the raw materials are completely digested. Such composts have a depressing effect upon the nitrogen level in soils similar to the effect of green manuring. Their value begins to show up only after many months, often only during the second year, as is the case when one uses fresh manure. Applications of these materials should be made in fall, never in spring just before seeding or planting. The same holds true for sheet composting of organic wastes and trash, and for partly rotted straw and sawdust compost. Well-rotted composts can be applied at any time although a moist soil is a better recipient than a dry one. Desert remains desert as long as there is no moisture.

Completely mineralized composts are the other extreme and cannot be called "organic fertilizers". In completely mineralized composts, however, the minerals are usually in a highly available form while in partly-rotted, raw composts they are usually unavailable.

From all these facts it appears that the proper degree of breakdown in a compost is important in determining the effective amounts to apply. If a compost with 2 to 3 % nitrogen, but not well decomposed (i. e. more or less raw) is applied most of the nitrogen is lost in the soil. One would fare much better with the 1% nitrogen of a well-rotted compost. In the latter, the nitrogen will be slowly and steadily made available to plant roots

and the microlife in soil. It should always be remembered that we feed the microlife first and only secondarily the plant root. It is the microlife in soil which turns the minerals into forms which the plant roots can take up, or not, as the case may be. (2) (3).

An ammonia odor in compost or manure indicates the presence of free ammonia. Since ammonia has a strong smell its presence is not always an indication of a high ammonia, i. e. nitrogen content. Fresh manure, after a few days, can really stink of ammonia and yet contain only 0.5% nitrogen. The ammonia odor, however, indicates that the ammonia is free, that it can easily be lost or washed out and only that much is used as the plant roots can absorb at once. The balance is readily lost unless there is nitrification or other fixation process going on in the soil. When the manufacture of compost from garbage was started and the product sold to farmers, we were especially proud of the fact that the compost had an earthy, agreeable smell. Some of the salesmen came back and reported that we should give it a stronger odor because the farmers said that it didn't have "that strong fragrance of manure". We thought that in the interest of nitrogen preservation and effectiveness it would be better to perfume the compost than to permit a decomposition with a strong ammonia smell. Without nitrogen fixation ammoniac composts have an immediate, but not lasting effect on plant growth. The plants may grow too lush and go to seed too early (under drought conditions), or set weak seed (under wet conditions), for most of the ammonia nitrogen is lost long before the plants mature. Too much of an easily available form of nitrogen may even lead to burns on plants as can be seen when fresh poultry manure or too much concentrated urea is applied to lawns.

Phosphates and *potash* are present in composts in both organic and inorganic forms, and are made available by soil bacteria and their enzymes no matter whether the chemical laboratory tests show them to be present in available or water soluble form or not. It is, therefore, in the interest of the compost producer as well as the compost user to create such conditions that an active microlife can be utilized. This is only possible in the presence of moisture, organic matter (the more the better), and aeration, that is, proper cultivation. The release of these elements in the soil is also slow and steady. In addition, in soils which have been treated intensively with fertilizers in the past, the increased microlife will bring tied down phosphates and pot-

ash back into circulation. The low P and K in composts (which usually range from 0.5 to 1.5%, in the best products up to 2%) are no obstacle since maximum effectiveness and availability are obtained. Again it should be remembered that the application rate for composts is quite different from that recommended for concentrated inorganic fertilizers. If 1 ton of compost at 1% P or K is applied to an acre this means that 20 lbs. of the corresponding element are given. Ten tons of the same compost contain 200 lbs., which in most cases is sufficient. Dry B. D. Compost Starter treated composts are actually *concentrates*, and the 2% phosphates or potash in them provide 40 lbs. of P or K per acre at the rate of 1 ton/acre—all available in due time, and no losses or tieing down are encountered.

It is our firm opinion, based on laboratory and field tests as well as on many years of practical application (4), that composting can be done very well along scientific, analytical lines. The first step is to know your compost and what it contains. You ought also to know your soils and the crop demands. Finally you ought to know the crop rotation and take into account the beneficial influences of legumes and green manuring.

A soil analysis will tell which elements are abundant and which are lacking or deficient. But chemical information about your soil is not the only important thing. It is the physical structure of the soil and the climate or weather which play a decisive role in the efficient and effective use of composts. Light, sandy soils can absorb large amounts of compost until they build up humus—organic reserves. Once a 2% organic matter level is reached they will make full use of compost as fertilizer. Below a 1.5% organic matter level part or all of the compost applied will be used either for soil building (when the compounds in the compost become available slowly), or as fertilizer (when the compounds are readily and quickly available ones). Soils below the 1.5% organic matter level have no reserves and live from day to day.

Medium-heavy clay soils with better than 2% organic matter are the ideal soils. Very heavy clay or loamy soils react sluggishly and large amounts of manure or compost have to be applied before you can see any results at all. However, these amounts are not lost, they are stored. It is more important to aerate and drain heavy soils according to the best knowledge of agriculture to make the best and most effective use of composts. These in turn aid in loosening up heavy soils and improve the structure. Once the structure is improved the full effectiveness

of composts as fertilizers will be apparent. In a garden raised beds, for truck and field crops furrow cultivation, will greatly improve such heavy soils.

The higher the organic matter level, the better the soil structure, the smaller the amount of compost which is needed. Good drainage is a must for efficient compost use. In wet, heavy soils no compost should be buried deep. The climatic conditions and weather also have a bearing on the rate of compost application. The general rule is that heat and drought destroy organic matter faster than cool and rainy climates. In hot, dry climates, as well as on light and heavy soils, it is more efficient to use smaller amounts and apply them more often. This practice is recommended, by the way, for all *difficult* soils. In such cases, yearly applications are preferable, while on well-maintained soils one heavier application once in a while (once in a four-year crop rotation, for instance) is usually more practicable.

Last but not least, the crop demands and crop rotation need to be considered. A general differentiation should be made between plants with high, moderate or low nutritional requirements. In using compost where we have a natural balance in the soil one can take a chance and think in terms of tons per acre, even though the NPK details are not known. However, to this writer, the full application of all possible information is always preferable. A commercial farmer should use all the information; the home gardener can risk getting away with a general application.

Heavy nutritional demands on soil are made by the following: Corn, tomatoes, potatoes, beets, peppers, cucumbers, spinach, chard, cabbage, cauliflower, endive, escarole, chicory, celery, squash, pumpkins, okra, rhubarb, sunflowers, roses, peonies and some other perennial flowers, berries, heavy-bearing fruit trees, nut trees, avocados, bulbs, lawns.

Plants which make *moderate nutritional demands* are: Lettuce, carrots, turnips, early garden beets, Brussels sprouts, kohlrabi, leeks, onions, most spring flowers, pasture and hay grasses, small grains, in general, shallow-rooting plants.

Light demands are made, especially in fertile soils with a high organic matter content, by radishes, most herbs (medicinal herbs in particular) legumes (peas, beans, clovers, alfalfa, and soybeans if allowed to mature), most summer and fall flowers, buckwheat, tall pasture and hay grasses with deep growing root systems. To be on the safe side it may be stated (with a grain of salt) that light feeders turn into heavy feeders on light, sandy

soils and any soil with a low organic matter content. Such soils should be given large quantities of compost and frequently.

RULE II: Adjust your compost to the soil and climate.

RULE III: Adjust your compost to the kind of crop you want to grow.

For *poor conditions* and *heavy feeders* use the maximum amount of 10 tons/acre of a good grade, wet compost (0.5-0.7-0.5 formula), or less, according to formula, of a dry, manufactured compost. The compost manufacturer should be in a position to advise the customer as to the proper use of his product. Unfortunately, this is not yet true in the case of most of the products advertized nowadays. These products may have a 2-2-2 formula at less than 20% moisture, then 2 tons/acre will be enough. Use 2 to 3 tons of a 1-1-1 formula at less than 20% moisture. These rates apply only to products which have an organic matter content better than 20%. Manufactured composts with 12-16% organic matter, as well as manures, have to be used at the maximum rate.

For *good conditions* and *moderate feeders* use half the rate of maximum demand, for instance, 5 to 7 tons of a moist, homemade compost or 1 to 2 tons of the B. D. Starter produced compost (dry compost below 20% moisture) of the average formula of 1-2-1.

For light feeders, minimum amounts can be used; a light sprinkling in a garden, 1 to 2 tons in the field. On good soils after a heavy or moderate feeder, compost can be omitted. On poor soils a light dressing is advisable.

The crop rotation in garden and field with compost management, on good soils, is best arranged in such a way that heavy feeders are provided with maximum amounts to be followed by moderate feeders with half amounts on good soils, to be followed with light feeders and no compost. On poor and difficult soils the old power of maximum amounts will probably last into the second year. Therefore, in such cases, it is better to use light feeders in the second year of the rotation with a light application of compost. This is followed in the third year by moderate feeders with a half rate application. In the fourth place in the rotation one can then again place the heavy feeders and apply the full amount once more. On good soils, in good condition, either a light or moderate feeder can be grown in the fourth year, before one returns to the heavy feeders with a full application. These rules should not be adhered to stubbornly, but used with common sense. Modifications are always possible. And we have not

included in these possible rotations cover and rest crops, or rest periods.

Mulching can be done with a poorer grade of compost which has not become earthy, that is an incompletely rotted compost. On dry and light soils and in hot dry climates, it is a must.

Green manuring crops, mown and top-dressed with a light application of compost, even of a poor compost, will be twice as effective as those not so treated. The plowed or disked in material will decompose faster and release its nutrients quicker without tying down nitrogen.

Thus far we have been dealing with the basic principles of composting and their ordinary practical application. A further development of these scientific principles in even more detail will form the basis of future articles. But on the basis of studies already made, it is evident that composts can be applied scientifically just like any other fertilizer, and application rates and the types of compost to be used figured out for any purpose and requirement.

The two tables printed on the folded insert will help you in working toward this scientific, economic, and effective use of your composts. The first table brings together all the information from the text of this article which will help you in determining how much of the various types of compost to use in general practice. With the help of Table II you can adjust your applications to the individual needs of any crop.

Our aim is to take the guesswork and happenstance out of composting and to make it as exact an agricultural science as possible. Farmers and gardeners who have done this have fared well over long periods of years. One observation, frequently made and confirmed, is quite important in this connection: the usual application rates especially of low grade composts have more than provided all the requirements of crops without causing any trouble in regard to soil structure.

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REPORT ON GOLDEN ACRES FARM

A Talk at the Summer Conference

Walter Stuber

Since addressing you last, we continued to carry out our plans and for the benefit of those who have not heard about our farm, I will briefly describe our over-all operations.

I wish to add here that since then we have learned a great deal about B.D. Farming and especially so in the past year when, instead of devoting my entire time to my business, I was able to devote much of it to the farm.

When I spoke to you three years ago, I explained how we have combined three adjacent farms into the Golden Acres Farm totaling 370 acres, of which approximately 320 acres are tillable or in pastures. The first farm—our Dairy Farm—we acquired over seven years ago and the last one—our Poultry Farm—three years ago. The farm my wife and I live on is our Orchard Farm.

In converting to a B.D. farm we have, no doubt, made as many mistakes as anyone else, and we still have much to do to live up to all the requirements and to try out all the suggestions. But if I had to come up right now with a quick all-embracing answer, I would in my own way of thinking say to you, that all that is necessary for good B.D. Farming is a large amount of well-prepared B.D. compost and for your pastures enough rain to keep the grass and clover growing.

In elaborating on this statement, I would like to say that with the help of Dr. Pfeiffer's B.D. Starter it is now comparatively simple to set up compost piles with standard farm equipment. In line with what I said about large amounts of compost, the minimum requirement of which is 10 tons per acre every 3 years, I believe—judging from our own dairy and poultry operations—one can produce this much compost very readily, provided one is prepared to grow one's own feed—and this is the limitation we have placed on ourselves—namely, not to raise any more animals—that is milk cows, laying hens and turkeys—than we can take care of with our own feed. The manure from these animals will provide at least the required 10 tons of compost per acre every three years.

Now in regard to the necessary water in the soil, I am limiting my observations to weather conditions on our farm in Eastern Pennsylvania where we usually have enough rain during winter and spring, though this spring the rainfall was less than in former years. In our experience we have found that wherever

we had used 10 tons of compost an acre, our soils would hold enough water to see our regular crops through a dry season, including our cornfields and to a lesser extent our hayfields.

In again referring to *compost and water* I want to add that in my planning for the future of our farm, we are arranging to produce more than the necessary 10 tons of compost per acre every three years—believing that the additional organic matter will hold so much more water for the dry season, and we are also planning the installation of an irrigation system for our pastures which we have reduced to about 30 acres for approximately 85 cows.

Last year, we built a ¾ acre pond. We have had a lot of hard luck with leakage, caused by the bulldozer in disturbing a rock formation at the bottom of the pond. We have not been able to correct this condition so far, though we hope to overcome our problems before long, and then we should have enough water to irrigate our pastures, which will be subdivided into 2 acre lots and used in rotation.

In trying to overcome the water problem which seems to be getting more serious every year, I should have added that in addition to compost, we expect to get a lot of help from our specific crop rotation.

To produce additional compost we have been fortunate enough—through Dr. Pfeiffer's connections—to get in nearby Philadelphia, a supply of commercially produced coffee grounds which averages about 5 tons per day throughout the year—more than doubling our compost production from approximately 1200 tons per year to 3000 tons.

On our Dairy Farm we keep 51 Guernsey milking cows which, with the young stock and 3 bulls, gives us an average herd of about 85 animals. On the Poultry Farm we have about 3500 Leghorn laying hens and about 600 turkeys. The Orchard Farm is still in its early stages with several hundred fruit trees planted three years ago, and another 900 going in this Fall or next. We have many Grapevines, Strawberry, Raspberry, Currant, Gooseberry and Blueberry bushes and about 1½ acres of vegetable garden; this we intend to increase in size as we go along. I wish to add that we are fortunate in having Wilko von Brederlow with us, doing all he can to keep this part of our activities going until such time as we can get two additional gardeners to build the Orchard Farm up to its potential production. As all of you know of mulching, and especially in view of Mr. Eddy's excellent success with same, we are laying our plans for

next year to mulch our entire orchards and vegetable gardens with straw, of which we now have an abundance. In doing so, we hope to be relieved of any serious kind of watering problem.

I am sorry to say that we will lose Peter Blaser who joined us a year and a half ago and who was instrumental in working out our composting method with ordinary standard farm equipment—setting up as much as 100 tons of compost a day. He will leave us this fall to go back to Switzerland to marry his childhood sweetheart. Besides taking care of all our composting including the inspection of the finished material, he also grew herbs and made his own B.D. preparations and helped on the Dairy Farm which is run by Carl Belke, our Manager and Paul Smith, our Herdsman.

The Poultry Farm is taken care of by Stefan Schaeffer, assisted by two helpers. In a very short time, he has put together a very promising operation.

We grind and mix our own feed for both—cows and poultry —and earlier this year we built our own slaughterhouse which is still to be equipped.

Then there is just one more thought that I would like to add, and that is—that everything we have done has been hard work, that there has been progress many times only by trial and error. My recommendation to anyone wanting to change over to B.D. farming is, not to expect it to come by itself but rather through careful planning, especially in its initial stages. Every now and then you will be faced with a new challenge to match your resourcefulness. But in the end you cannot fail to succeed. Alone the prospect of not having to buy any more fertilizer or lime or rock phosphate is rather gratifying; but you will have done a great deal more—you will have brought your soil back into a healthy, natural balance, and you will be able to face a dry season or too much rain in a very assured mood, and you will have brought health to all living beings on your farm.

BOOKS RECEIVED

"Plant Regulators in Agriculture", H. B. Tukey, editor, published September 3rd by John Wiley & Sons, Inc., New York. A review of this important book will appear in our next number.

IMPRESSIONS OF THE FARM CONFERENCE

EVELYN SPEIDEN

All the scientific and practical essentials about COMPOST; a heart-warming, inspiring and fruitful demonstration of cooperation: these filled my thoughts coming away from the Farm Conference. Scientific details you will find elsewhere in this issue; here, perhaps, the feeling of having been there.

"For farmers only", we had replied again and again in the weeks preceding this first Bio-Dynamic Farm Conference, held by invitation at Golden Acres Farm near Newtown, Pa. The Association was grateful to accept Mr. Stuber's offer as here one can see a demonstration of applied Bio-Dynamics that can scarcely be described without each of the following adjectives—economically-efficient, labor-saving, understanding, comprehensive, persevering. Yet this Conference was a new venture. We were uncertain if those to whom it would appeal could come. Hurricane results kept some at home, likewise corn harvest, lack of help, etc. Nearing supper-time on Friday, Dr. Pfeiffer was overheard to remark half-jestingly to Mr. Stuber, "Now Walter, I hope you won't be disappointed if nobody comes to this Conference." He need not have worried. Within two hours there was no space left in the ample parking area. They came from nearby places, from western and central New York State, from New Jersey, New England, Maryland, Missouri, Wisconsin—over thirty-five persons in all. And Mr. Stuber had ordered only thirty chairs for the big garage in which we met. But there were benches, a blackboard and fortunately some heat, as it was chilly and damp everywhere. It rained during our meetings; it rained at night, but not one drop fell while we needed to be outdoors.

Friday evening we began to get acquainted. Mr. Stuber introduced us to the Farm by way of a large map, and passed out smaller copies. We saw the location of the Dairy Farm, managed by Mr. Carl Belke, with its barn, residence, pastures, crop-rotated fields for grain and hay from which all of the feed for the cattle comes. In the opposite direction was the Poultry Farm where chickens, geese and turkeys with all their feed, are raised. Mr. Stefan Shaeffer and his family live there and manage this section. The region surrounding the Stuber home and the garage where we met, includes the home vegetable garden, beginning truck garden, a small greenhouse and a great variety of fruit. Finally Mr. Peter Blaser gave the paper on compost making (in this issue) to prepare us for the following morning.

Saturday at 9 a. m. from the garage we went together to the Dairy Farm and the largest, but not the only compost production area. There stood the equipment,—a tractor with scoop, a jeep carrying tank and pump with hose connections, connected with power take-off to an ordinary manure spreader, most of which the average farmer already has and can easily adapt for large-scale compost making. Mr. Stuber said, "We set out to find the best equipment that could be gotten for this purpose and ended by using this ordinary pump with a few bolts and screws, pipes and nozzles."

The wet weather underscored the value of the 100 by 100 foot concrete area. In spite of a few puddles the machinery could function and the people get around as would have been impossible in mud. True enough Bio-Dynamics has always emphasized that a foundation in direct contact with the earth is essential for top quality and quick decay of compost. The method here is to collect all materials on "The Slab", as those from Missouri would say, with space around and between for manipulation. Long piles are built at the edge of the Slab. After reaching the proper stage, they can be turned over onto the surrounding earth for completion. Weather and soil conditions have to be right for field spreading anyhow, but other compost work can be done here regardless. We watched as Peter Blaser made a pile, the Ford tractor with scoop running back and forth from manure spreader to manure pile, to the heap of coffee grounds, and to another mound of earth and half-decayed compost. After the five scoopfuls were dumped on the spreader, he started it moving. It was mixed as it moved backwards, passed under the Starter spray and fell on the pile. He kept adding more raw materials and occasionally moved the spreader forward a little as the pile grew. It took only six minutes to make a ton. Thanks to the coffee grounds (he would get something else if this were not available, he said) Mr. Stuber is making twice as much compost as is ordinarily advocated for his crop rotations. Thereby he gets ahead far more quickly to the maximum productivity of his land, with consequent labor-saving, health-producing and money-making maxima as well, also to the point where he will be able to sell some compost instead of using it all.

We dug into some older piles and Dr. Pfeiffer explained what we saw, giving varied

Compost Pointers

One pile well under way (typical, he said) showed the outer six inches in good condition and pretty well decayed, then a hard,

gray layer of perhaps four inches, with the inside still hot and in the process of fermentation. The gray color here is not mold or "fire-fang" as usually seen in manure or compost, but certain bacteria (due to Starter).

Such a pile should be watered six days after making. Bacteria drink water plentifully as they grow. In 85 lbs. of a fresh compost mixture, 50 lbs. will be water . In three days 30 lbs. of this water is used up by the bacteria (not evaporated). Rain does little good here as it runs off instead of sinking in deeply. Water a pile by making crowbar holes in it.

If a pile is too wide and high there will be an anaerobic core with undesirable fermentation.

Any greenish or yellow color inside a pile indicates anaerobic fermentation. Avoid or get rid of this by mixing.

In commercial production, we keep a thermometer in the pile and find that after each stirring or moving of the material, the temperature goes up again for awhile, independently of surrounding air temperature. It is a cyclic process with two definite change points each day.

Watching moisture and temperature of a pile, we know from much laboratory work, exactly what goes on there.

As long as a pile is acid, there is no humus fermentation; yet with the Starter we find it unnecessary to add lime.

Speed in fermentation is not desirable for home or farm piles. In commercial compost making it may be different.

Commercial compost must be well-decayed and partially dried for bagging. Home compost, we know now, is better spread before it is fully decayed, in many cases. Twenty years ago our ideal was really compost earth, a thoroughly disintegrated mixture. Now we know that this has lost about 50% of its organic matter and some of its nitrogen.

Use half-decayed compost for corn and tomatoes, well-decayed for potatoes, other vegetables and for pastures.

Apply half-decayed compost in Fall, well-rotted in Spring.

In general, plants which have the greatest expanse of root system carry on the greatest underground activity and so can digest the half-rotted compost. Size of root system has a direct relation to quality of compost, but this has not been sufficiently investigated.

Earthworms cannot come into a pile on a cement base, but they would not anyway during the early stages when the temperature is over 90 to 100 degrees. Now that we spread a pile earlier, worms can work in the material after it is on the field.

Never plow compost in deeply. Keep it in the top six inches of soil. It is better to disk rather than plow to mix soil and compost.

An earthworm fermentation is a cold fermentation and in many ways a good one, but it does not take care of paper and some other things.

Compost may be used when (1) its moisture content is less than 30%; (2) it is alkaline; (3) its temperature rise is minimal, that is if there is very little difference between the pile's inner temperature and that of the air.

It is interesting to compare this with a standard for judging compost which Dr. Pfeiffer used to give years ago, that there were three stages in the fermentation of a compost or manure pile:

(1) when it loses its original odor and takes on a woodsy smell;
(2) when it changes its color to a uniform dark brown;
(3) when it loses its original texture and becomes like earth.

He said then that it might be used in emergencies after the first stage, but that the ideal was to wait through the third.

Following the compost demonstration we were glad to sit awhile on benches under the overhang of the dairy barn while Mr. Belke talked about his crop rotation. Various questions came up for discussion, always including compost, of which we saw more in the afternoon trip to the Poultry Farm. Both in dairy barn and poultry house we saw another thing typical of Golden Acres Farm,—the engineer's approach with labor-saving and economic efficiency always kept in mind, though nowhere have basic Bio-Dynamic ideals been forgotten. Nothing is so well finished but what it may be improved if a more simple way is found that could be useful to the average farmer. How to get the milk from cow to distributor—and later perhaps direct to consumer—with the least expenditure of energy and the greatest conservation of milk quality, involves many problems currently being solved in varied ways. The average farmer is familiar with these but he does not have the time or money to try out first one way and then another himself. Mr. Stuber has his eye on them all—and more—to sort out those most in line with Bio-Dynamic ideals.

The Poultry Farm is like nothing we ever saw before: a few geese, more turkeys, several thousand chickens, 700 of them ar-

riving every 2 months as day-old chicks. A tremendous old barn has been remodeled and enlarged, so that not only are three stories of laying hens spaciously accommodated, provided with automatic feeders, but there is room for storage, preparation of feed, handling of eggs and broilers, etc., for market, and for all the activities that go with poultry. Batteries—none. Row above row of regular nests are all on one side of each big room, with well placed roosts on another. We watched from the halls through glass as the beautiful white layers moved about calmly on the thickly straw-littered floor. More compost material! Time clocks control the lights at night with fifteen minute red lights to get the birds on perches after the other lights go off. But this is a mere beginning on the subject of poultry. We hope someone will write it up more completely later.

Among those present were the Eddys from Rhode Island and the Philbricks from Missouri, with whom our readers are already well-acquainted and both of whom are specialists, among other things, in making bio-dynamics better and more widely known. Saturday evening we relaxed and laughed with Rev. John Philbrick over their experiences in building up a Bio-Dynamic homestead in Missouri, during the last few years since they moved from Duxbury, Mass. He does not only regular pastoral work, but is part of an organization to train young ministers for rural parishes, a work in which his delightful sense of humor comes in handy. Helen Philbrick wore a suit she had woven and tailored herself. Both are expert weavers.

Shortness of time bothered us most on Sunday morning's exploration of the home vegetable and fruit growing areas, so many were the questions and so intense the discussion as we walked around munching carrots we were permitted to pull. Mr. Wilko von Brederlow is in charge of all this and it would be hard to find anyone with so thorough an understanding of its problems and possibilities. He has been with Bio-Dynamics since its very beginning and is one of the few persons left who was present thirty years ago this summer when the first Bio-Dynamic Conference was held at Koberwitz, in Germany. The fruit trees showed a band of tanglefoot and a wire guard against mice and rabbits. They have had routine B. D. treatment—compost (not manure) after fruit harvest time, sprays 500, 501 and 508 at the proper times, and tree paste in the late fall. This year many trees have borne their first crop without benefit of the usual commercial treatments. Yes, it can be done, but it needs determined and persistent Bio-Dynamic work, not just a passive

omission of practices of which one may not approve. The strawberry bed was planted in mulched rows, with runners cut off to make better berries. Mulching is practiced as much as possible. A phalanx of compost piles runs down one side of the garden. Herbs were with the vegetables. Everything looked healthy and the carrots, we know, tasted good, as well.

Just at eleven o'clock lecture time, rain made us run for cover. It was Dr. Pfeiffer's lecture, a high point of the Conference. You can read it in this issue, and then you too, will be thinking more and more in terms of compost.

We drove seven miles to the Fetzer Farm for living accommodations. Many readers will know from experience the kind of hospitality to be found at Fetzer's. Besides doing B. D. work in farm and garden, Fetzers have for many years conducted a guest house during the summer months where families come back year after year for much of their vacations. So we reaped the benefit of their experience in well-planned meals, expert service and homelike atmosphere in which to relax by the open fire between sessions. Ten-year old Ursula Fetzer will remember this Conference as the first occasion on which she was permitted to help serve tables. And we will remember not only her proud and capable work, but also that of her two older brothers as they took charge of the barn at milking time so father could be free to show Conference guests around the Fetzer Farm, a real family project, with Mrs. Fetzer as presiding—and working —genius in the home area. In spite of the extra work, she managed to attend many of the Conference sessions.

Of course Sunday dinner at Fetzer's was a festive occasion. Josephine Snyder Porter with two weeks old Abigail, a Bio-Dynamic Farm baby, stopped by to share it with us. Josephine has not missed a Bio-Dynamic Conference in many years, so we were glad to see her again even if only for dinner. Centerpieces on the table were well-rounded heads of colorful purple cauliflower, to show us what was on our plates. It turns green when cooked, but has the true cauliflower flavor though it grows like broccoli, a new vegetable worth trying.

The sun was out again for the trip around the Fetzer Farm after dinner. We thought of what Dr. Pfeiffer had said that morning, "The creation of good soil conditions should be the number one expense on a farm. Two things I would do first, even if it meant mortgaging a new farm to the limit to accomplish them: (1) the production of material in quantity for good compost, (2) the provision of good drainage,—no composting

project will succeed without drainage." Here drainage has been the problem. Unfortunately the Fetzer Farm is mostly located in an area with a high water table, poor drainage and heavy soil. If he had known as much in the early days as he does now, says Mr. Fetzer, he would have sold the farm instead of spending the effort and money that has gone into drainage. Over many years he has tried again and again with alfalfa, seen fields well started only to have them heaved out and killed over winter. Practically every suggested remedy for bad drainage has been tried. Laying drain tiles has proved the best solution. Now the results of years of fertilizing efforts are evident in the lush growth of clovers and mixed grasses in pastures and hayfields.

Truly this conference was far more than just very interesting meetings with good meals between. To quote Dr. Pfeiffer again, "Mr. Stuber has approached farming as an engineer, I have approached it as a soil chemist. Our thoughts have arrived at the same point." That means real cooperation, not always agreement at every point, but a determination to work it out for the sake of an ultimate good that is of more importance than any single individual's personal opinions. Contributed to this occasion were not only Mr. Stuber's years of experience as industrial engineer and businessman; Dr. Pfeiffer's scientific and agricultural background with years of research along these lines; but also Mr. von Brederlow's lifetime of working with the Bio-Dynamic method; Peter Blaser's ingenuity and inventiveness in working out the whole compost project; Mr. and Mrs. Fetzer's years of applied nutrition, making their vegetable garden, poultry and dairy pay off by way of the kitchen and diningroom while farm difficulties were being worked out; and other skills too numerous to recount. Probably a century and a half of specialized experience was woven together with many varied and complementary abilities to make this conference. With such weaving what may we not expect for the future of Bio-Dynamics?

And it is something for the future, perhaps even more than for the present, and for those who will make the future. Several present at this Conference had young folks back home with whom they must have wished to share the Conference sessions. Next year, if Mr .Stuber invites us again, let's give the young people a chance. What could be better calculated to give them a wholesome respect for modern farming? Can you think of one or more young persons with basic farm interest, who might, with your help, attend another such Conference?

COMPOSTING ON THE FARM WITH B. D. STARTER

PETER BLASER

In publishing this valuable paper, delivered at the recent Farmers' Conference, BIO-DYNAMICS *feels that acknowledgment should be made not only to the author but also to Walter Stuber who gave the encouragement and free hand with the work that made this material possible.*

Whether a farm can supply itself with enough fertilizer to raise and maintain production on an economic level is a question of management—it depends on the farmer himself.

In chemical farming the problem of fertility is regarded primarily as a problem of replacement—in B.D. farming we look upon it first of all as a problem of availability. We are very likely still far from being aware of all the factors of availability. Some old-time farmers still have a feeling for the right care of their soils, crops and animals; most of us however have to do it the hard way, gaining our knowledge by practical experience, close observation and study.

Instead of trying to get into any theoretical explanations, I would like to refer to Dr. Pfeiffer's work, which is open to us in his basic book '*Bio-Dynamic Farming and Gardening*' and in *BIO-DYNAMICS*. Especially his last report in the summer issue of the magazine, gives us an idea of what soil science has got to get into in the years to come in order to solve the problem of fertility, i. e. availability. With this summing up of his research work in the field of soil science Dr. Pfeiffer actually opened the gate from the orthodox theories to an understanding of the soil as a living organism which has its own dynamics and its own biological laws.

Before giving you a detailed description of our method of composting I would like to bring to your attention a few points which are of interest in this connection:

What are the farm's own resources of fertilizer?

The most valuable source is the manure from all the animals which are fed on the place, preferably with as much homegrown feed as possible. It should definitely be composted either with the B.D. Starter or the B.D. Preparations, as this is one of the strongest links in successful B.D. management. Sod and crop residues furnish a considerable amount of organic matter and nutrients, and hold moisture for the following crop if decayed properly. The use of the B.D. Starter as a field spray is the best

means yet developed to assure a proper breakdown process and humus formation, provided this process can take place under aerobic conditions (i. e. as near to the surface as the type and structure of a soil requires to assure this condition). Green manure in the form of cover crops and intercrops is an excellent help in adding to the fertility of the soil and improving its tilth, if it has a chance to decay properly. Garbage and other organic waste is well worth adding to the compost.

How much compost do we need for a given acreage?

This depends entirely on the type of farm and farming and can be answered only individually. It might be of advantage however, to make use of other sources of raw material from outside, as we do here with coffee grounds at the present time.

Can the average farmer afford to make compost?

This is, as stated before, a question of management and organization. Equipped with a power take-off type manure spreader and a tractor loader there is little doubt that he can at least make compost of his manure. Whether it is economical to bring in organic materials from outside depends mostly on the cost of transportation in relation to the fertilizer value of such materials, which in most cases is below that of manure. A more complicated setup for mixing rather than just piling the materials is needed. An approximate figure for the cost of production per ton of compost on this farm will be given below.

A DETAILED DESCRIPTION OF THE COMPOSTING METHOD DEVELOPED ON GOLDEN ACRES FARM

Equipment:

A Cobey power take-off manure spreader.

A jeep with p.t.o. to drive the spreader.

A tractor equipped with a frontend loader.

A self-powered ½ h.p. rotary pump and a 50 gal. barrel, both placed on the back of the jeep.

A 350 gal. tank wagon to haul water for the Starter solution; this is also used to haul liquid manure and in watering the compost piles when necessary.

Working Area:

For the dairy farm a 100 x 100 foot concrete platform was built, which we later enlarged by adding a 15′ apron of bare dirt all around the platform, surrounded by an embankment 3′ high, to work against when loading with the tractor scoop. This enables us to work with machinery also during the wet season and still take advantage of the benefit of bare soil as a base for the

compost piles. We stay on the platform for mixing, where we also leave the piles for the first period of fermentation. After three to four weeks we turn the piles over to the dirt apron where they are allowed to ripen.

On the chicken and orchard farms we use the corner of a field for our work area, since we can usually wait for dry weather there. On it, the compost piles are built in the direction of the slope, starting at the lower end, far enough apart to allow excess rainwater to run off.

Raw Materials:

Our mixture at the present time is made up of 40% manure, (either cow or chicken manure), 55% coffee grounds, (which come in at the rate of 40 tons a week), 5% dirt or half-rotted compost. (Percentages given are by bulk.) These materials are dumped about 20′ away from the future compost pile.

Setup:

The jeep with the pump and the Starter-filled barrel and the spreader are set up at one end, in the direction of the compost pile to be built. According to Dr. Pfeiffer's instructions the proper amount of B.D. Starter per ton of raw material to be mixed, has been moistened the day before and left overnight at room temperature. For a full work day 6 lbs. of Starter are prepared and 16 oz. of it are used each time in refilling the 50 gallon barrel, which is enough for 10 tons of compost.

The pump with its suction hose stuck in the barrel is connected by a piece of garden hose to a homemade nozzle mounted on the rear end of the spreader. The suction hose has a homemade strainer at the end. The 2″ outflow of the pump is narrowed down to a twoway outflow of ¾″ each. One end feeds the nozzle, the other end returns to the barrel to keep the solution stirred up. The non-clogging nozzle, a simple piece of ½″ steel pipe in which a slotlike opening provides for an even spraying over the full width of the spreader is directed toward the beaters. The water tank is kept nearby, and it should take but a few minutes to refill the barrel.

Operation:

First the spreader is filled alternately with two medium scoops of manure, two full scoops of coffee grounds and a small scoop of dirt or old compost. Light and coarse materials should go in the bottom of the spreader, heavy materials should be placed on top. Then the jeep is started, its power take-off driving the stationary spreader. The pump is also started, to spray the Starter solution on the materials as they unload and mix evenly,

through the action of the beaters. The spreader is then refilled continuously while in motion, and as the pile gets built up to about 4′ the jeep and spreader are moved ahead about 2′ at a time. This is a one-man operation, and it takes less than one hour to mix and pile 10 tons.

CONTROL AND FURTHER TREATMENT OF THE COMPOST PILES

The principal factors for a successful compost pile, besides the addition of the B.D. Starter, proved for us to be aeration, moisture and warmth. The failure of any of these factors may delay decomposition and the action of the Starter. In addition, too much air and too little moisture may cause considerable losses of organic matter through a slow process of burning; too much moisture may cause leaching of nutrients.

Aeration:

The manure spreader builds up compost piles with a sufficiently loose structure to assure proper aeration for the first three to four weeks. After that it becomes necessary to turn the piles over, preferably with the inside out, as decomposition always starts from the outside in, while the inner part of a pile stays undecomposed for a long time. Other, improvised measures of aeration have all proved unsatisfactory so far. The turning over is done with the tractor loader.

Moisture:

The materials should not be sticky-wet nor dry, but should hold a reserve of suspended dampness which shows up as free moisture when they are squeezed between the fingers. Dr. Pfeiffer recommends 40%. Too much moisture destroys the structure necessary for aeration; this condition can be helped only by turning the piles over. During the wet season it is very important to provide for drainage of excess rainwater. The compost piles should never stand in water. As Dr. Pfeiffer says, "they should never have wet feet". Too little moisture is corrected by watering, and a pitchfork should be at hand when this is done to check how deep the water actually penetrates. It is surprising how much water a pile will suck up once it has gotten too dry. We collect the liquid manure and use it for this purpose. It is our experience however, that watering, besides being a time consuming affair, destroys the structure of a compost pile, especially if finely ground materials such as coffee grounds make up a considerable part of the mixture. It is better to moisten the raw materials enough before or during mixing and then pre-

vent too much evaporation by covering the piles with straw, old hay or a thin layer of dirt. The balance between solids, air and moisture should be watched closely in order to furnish the most favorable conditions for bacterial action.

Warmth:

A certain amount of heat has to be created for a quick and effective decomposition; this is not possible when the compost pile is too small or when it is built up in thin layers, one at a time. Such conditions are favourable for earthworms of course, but this process is too slow for operations on a larger scale. We have found the most practical size of compost piles to be about 9′ wide at the bottom and 6′ at the top; the height is limited by the spreader to about 4′. Our piles reach a temperature of around 140 to 150 degrees F.

When Is the Compost Ready to Use?

This is a question which is not yet fully settled, but it is quite obvious that field crops respond better, quantitatively, to a compost which is not entirely decomposed, especially if it contains a considerable amount of manure. This might look different from the point of view of quality. The compost we used on the silage corn was only partly decomposed and we are quite satisfied with the result. For the pastures however as well as for fruits and vegetables we prefer a well-rotted compost of an earthy structure and a pleasant smell.

Application:

Applying the compost to the top 3-4″ of the seed bed has definitely proved to have a better effect than ploughing it under. The rate of application depends on the soil type and its condition, its state of fertility and on the crop to be planted. A run-down soil of course requires a lot of compost to bring it back to good productivity. But green-manuring with sweet clover, rye grass or small grains, in a mixture with vetches, should raise the fertility of such fields considerably without too much expense, if the crop is sprayed with B.D. Starter before ploughing. Only small amounts of compost are needed in this case or even none at all if not available. Best results can be expected from crops of the legume family, but they do not thrive under all conditions, especially not in soils with a pH lower than 6. To give you a general idea, we think that with 1/3 of our fields laid out to clover and grass for hay, we will need about 10 tons of compost per acre every third year.

Cost of production:

By my own rough estimate, without including the value or price of the raw materials, just for the process of composting itself I figure our expenses in producing one ton of compost as follows:

Starter	$1.00
Labor, (mixing, control and further treatment)	.75
Machinery, (gasoline, oil, grease, repair, depreciation)	.65
Total	$2.40

THE B.D. STARTER USED AS FIELD SPRAY ON CROP RESIDUES AND GREEN MANURE

We use the same self-powered rotary pump and a barrel on the back of a jeep as described in the section about our composting operation. As a sprayer the Kromer Broadfan Sprayer is attached to the drawbar and connected to the pump with a short piece of hose in about two minutes. The barrel is filled with water and 1 lb. of Starter, which is enough to cover four acres. Driving at 6 mph. and spraying 30′ wide, it takes about 10 minutes to spray four acres with this setup. The spraying should be done immediately before ploughing or disking especially in dry weather. The Kromer nozzle is supposed to be non-clogging, but I had to loosen the two screws which hold the steel plate at the end and put a small piece of tin between the brass part of the nozzle and the plate to make the opening a hair larger. This way, everything will go through which passes through a fly-screen strainer.

Parts to order from O. W. Kromer, Minneapolis, Minnesota:

No. 580 hand gun valve
582 hand gun valve—lever
584 hand gun valve—clip
581 tube
740 broad fan nozzle
743 angle clip
744 lower tube
745 upper tube
746 clip

(The 411 strainer clogs up unless the solution is passed through a cheese cloth.)

Regarding the results of the use of B.D. Starter as field spray we have only one year's experience behind us, but as our crops did better than we could expect, where the Starter has been sprayed, we believe that it is a great help in raising b.d. crops.

FURTHER SUGGESTIONS FOR COMPOSTING OPERATIONS

Composting Manure Alone:

Our process was developed for mixing manure with coffee grounds. If manure is the only raw material to be composted, it will be simpler to apply the B.D. Starter with a sprinkling can on the manure in the gutters, in the chicken pen or loafing barn, according to Dr. Pfeiffer's instructions. The manure should then be loaded directly on a p.t.o. type manure spreader and piled up at once. This saves a second handling and eliminates the above-described spraying arrangement. To make compost piles by simply dumping the manure without letting it pass through the spreader will cause the structure to be too compact and consequently will give you poor aeration and delayed decomposition.

Control and further treatment will be the same.

Composting in Layers of One Foot:

The fact that decomposition always starts from the outside of a compost pile and reaches a depth of about one foot within a few days, while the materials below stay more or less undecomposed for a long time if not turned over, directed our interest to composting in layers. We were not able to work out this method to a point where we could give definite instructions, and the following should be taken only as a suggestion.

This process would be quite simple if a spreader with side delivery were available to make the layers. Mixing with an ordinary spreader means that the layers will have to be made with the tractor loader after the mixed materials have been allowed to ferment for about three weeks. The procedure would be first to estimate the amount of compost to be made in periods of 3 weeks, then to choose a suitable place for composting. It should be long enough to provide approximately 15′ for each ten tons of compost to be made within 3 weeks. To start out, a regular pile should be built along the outside of the chosen place. This pile should then be turned over after three weeks to have a basis upon which to build the one foot layers. Right after this, a second pile should be made alongside the first one, with a square section of not more than 8-10 sq. feet. After 6 weeks the second pile should be turned over on the first one with the tractor scoop in a layer about 1′ thick. This layer would have an excellent aeration and the old pile underneath would give off enough heat to assure quick fermentation and decomposition. And again a new pile can be built alongside which in turn can be added as

a 1′ layer 3 weeks later. The Starter should be added each time a pile of new materials is mixed and care should be taken that the materials are moist enough.

The advantage of this method would be better aeration, and enough heat would still be created, which means much quicker and more even decomposition. Also considerably less space is required as the layers can be built higher than single piles because the materials underneath are already decomposed. And the empty space between piles is eliminated.

A Way to Save the Summer Production of Manure for Composting:

To keep the cows in or to collect the droppings is impractical and out of the question. A way out would be to leave the cows in the pasture only as long as they really eat each time after milking, and then let them come back to a sheltered dry plot where they have access to water and maybe hay and silage when pasture is short. This plot should be bedded down and the B.D. Starter applied each time before a new layer of bedding is added. It could be cleaned out once or twice during the summer with the tractor scoop and spreader and set up in piles for fall application of compost, especially for pastures. The result would be a more effective fertilizer, less droppings in the pasture and consequently more even grazing; less grass would be spoiled and the soil would not get packed so much during wet weather.

FIELD COMPOSTING WITH B.D. STARTER

The term Field Composting is used to distinguish the method suggested here from sheet-composting, in which latter I cannot see more than a conventional farm practice under a new name.

The success of this method will depend on:

1. *The use of the B.D. Starter* (eventually along with small amounts of compost or manure) for the same purpose as in the compost piles, to direct and speed up decomposition. (Field Spray.)

2. *A proper soil management*: Just like the process of decomposition in the compost piles, the soil building process starts from the well-aerated surface and moves slowly towards deeper layers, under favorable conditions. This process is influenced first of all by the type of soil, moisture, drainage, aeration (i. e. structure), organic matter content, and microlife.

In order to plant crops we have to disturb the natural process of soil building and its plant life which provided the huge

original humus reserves in our soils. In most cases, except for pastures and hayfields, a monocrop has to take the place of the harmonious association of wild plants which, from the point of view of farming and economy, have to be considered as undesirable weeds. But the more severely we disturb this process by deep ploughing and cultivation, as well as by removing from the soil the natural mulch, the more we work against nature, the more trouble we can expect. And the better we can re-establish and maintain the proper soil building process the more successful in the long run our operation will be.

PRACTICAL CONCLUSIONS: A piece of equipment has to be developed to aerate heavy soils and prepare a good seed bed without turning the topsoil upside down and burying the organic matter of crop residues and green manure. As long as we don't have it, the plough will remain in its position as key implement and symbol of good farming. Disking would fill the requirement of mixing the organic matter with the well-aerated top layer of the soil, but it is definitely inadequate for restoring the proper structure of a soil which has been packed and mistreated throughout the year with heavy machinery and monoculture. What we can do now is to use the plough at times when the least organic matter will be buried, as far as this is possible. In the case of green manuring this would mean to plough before the green manure crop is planted. Then, later, shred the crop with a rotary cutter and spray it with Starter, adding a small amount of compost or manure if available. Then cultivate the field with a field or toolbar-cultivator, 6-8″ deep. A disking should follow soon thereafter and once more about two weeks later. In four weeks the field should be ready for planting, after another harrowing and possibly culti-packing immediately before planting.

When other organic materials such as coffee grounds are used for field composting they should be added after ploughing and one disking, four weeks before planting. Otherwise the procedure would be the same.

3. *A crop rotation which includes cover and intercrops for organic matter supply.* The 7 year rotation now introduced at the Golden Acres Dairy Farm is:

1. field corn, (cover crops of rye and vetch)
2. silage corn
3. winter barley
4. hay
5. hay

6. silage corn
7. winter oats, (green manure crop of rye and vetch or silage crop of sudan grass and rye).

Here field composting is feasible only after the field corn, and after the winter oats, possibly also after the second year of hay if the field can be ploughed after the second cutting of hay and a green manure crop is planted. The sod from the hayfield would be well-decomposed by corn planting time and the green manure field compost would serve as a most valuable mulch for the corn, if one proceeds as outlined under No. 2.

As the corn does not have to be planted before the middle of May, and there is usually a period of nice weather in late March or early April, it should be possible to carry this operation out successfully.

The system of field-composting could be adapted easily to other crop rotations by keeping the following points in mind:

The organic material should have at least four weeks time to decompose after the addition of the Starter and the first cultivation.

Deep ploughing should be avoided or done before planting the green manure crop or before the addition of other organic materials.

A legume should be added when planting green manure or cover crops, as a source of nitrogen which is necessary for the process of decomposition, or it should be replaced by adding a small amount of manure before starting the process of field composting.

The field should be well drained so that the heavy April rains do not interfere with the above-described procedure.

The disk-harrow should not be used more than twice before planting, as it is apt to make too powdery a surface, which crusts readily after rain. A field cultivator should be used instead.

SUMMER CONFERENCE NEWS

FRED HECKEL

The constant spreading out of interest, among more and more people, in the Bio-Dynamic Method of Farming and Gardening, was amply demonstrated at the Conference held at Threefold Farm, July 30 through August 1. Although advance notice was short, the housing facilities were strained to the limit, and old and new friends from many parts of the Country came to Spring Valley, N. Y. to take part in the activities of the long weekend. The interest too, of those present, was less than ever centered on subsidiary questions of diet and personal health and more on the prime purpose of the B. D. Association; the improvement of soils and crops by the application of tested, scientific methods of organic management.

As our hard-working secretary-treasurer, Evelyn Speiden, put it afterwards, "The biggest value of these meetings is the chance they give us to get together with good friends we don't see from one year to the next, and exchange our farming and gardening experiences in a way you can't do by letter".

There was a lot more to it than just that, of course, and those of us who for one reason or another didn't get there will be interested in at least an outline of what went on during the three days.

On Friday, the 30th, people began pouring in, and soon there were little groups in animated conversation to be seen all over the place. The sessions began at 4 P. M. with an interesting talk on beekeeping by Miss Speiden. In the evening, Walter Schonbeck gave a lively report, that was both human and factual, on the five years that he has been working on the Pfeiffer Farm at Chester, N. Y. It dovetailed beautifully into what Dr. Pfeiffer himself gave us on Sunday when he dealt, from a scientific point of view, with the progress that is going on there through the years.

The Saturday sessions were opened with a talk by Alice Heckel, giving practical hints on the handling of small orchards, berries and shrubs. Erica Sabarth followed with an interesting paper on "Trace Elements". The first part of the afternoon there were visits to a number of local gardens, and later the annual meeting of the Bio-Dynamic Farming & Gardening Association, with the President, Ralph Courtney of Threefold Farm, in the chair. At this meeting Miss Speiden gave an interesting account of the beginnings of Bio-Dynamic work, just 30 years ago in

Central Europe, when Dr. Rudolf Steiner gave a course of lectures out of which the whole history of field use and laboratory testing of the method has developed. In the evening, Charles W. Eddy, whose phenomenal results with heavily mulched vegetable gardens in very small areas have been reported here in earlier numbers, gave a fascinating, illustrated lecture on recent developments in his work. Mr. Eddy, who makes a very complete use of B. D. fertilizers and sprays in connection with his gardening, has done much to interest widening circles of people in the Bio-Dynamic Method.

Dr. Pfeiffer himself opened the Sunday morning sessions with an intensely interesting lecture on the proven results of the B. D. work at his own farm at Chester, N. Y. The lecture was based on the detailed report entitled "Seven Years of Soil Survey on a Biodynamic Farm," published in our Summer 1954 number. He was followed by Walter Stuber of Golden Acres Farm, whose report is included in this issue.

Peter Escher, out of his own long and varied experiences as a farmer and a farm and garden adviser, gave many practical "pointers on farming and gardening", as will be evident to our readers from the report of his talk in this number. The working sessions closed with a visit to the Biochemical Research Laboratory, where those present were shown something of the latest work being done by its small, hard-working staff, under Dr. Pfeiffer's leadership and direction.

The Conference, however, was not yet over. Most of those present stayed on for the evening, at which they were treated to an artistic performance on the stage of the Threefold Auditorium. Here they saw examples of the application of another contribution from Rudolf Steiner in a quite different field—the art of Eurythmy. The eurythmists were Elisabeth Baravalle Kimball, Sabina Nordoff and Hanni Schlaefli. Part of the evening was given to a piano recital by Stephen Portman, who also accompanied some of the eurythmy numbers. Others were done to the recitation, individually and in chorus, of Bettina Kroth, Swain Pratt, Blanche Rossé and Howland Vibber.

COMPARISONS BETWEEN FARM AND GARDEN PRACTICES

A Talk Given at the 1954 B.D. Summer Conference

Peter Escher

Such a comparison is difficult to attempt, and necessarily sketchy.

The farmer is more conservative, often due to his very temperament. He has to make ends meet. He loves his soil and lives with it. He has found that the fertility of his soil cannot be improved rapidly unless he finds a new source of water for irrigation. He often plans years ahead, and it is good practice to do so. I might add that *for the individual* it is good practice. For the nation at large it has helped contribute to a surplus, but this simply indicates how difficult it is for the farmer to adjust himself. Industry can increase its productive capacity or reduce it with relative ease. The farmer, being conservative, is slow to adopt changes and then does so only after he has SEEN. Also, the farmer in a particular area is economically limited to a certain type of crops due to climatic, shipping and labor conditions.

The home gardener's principal consideration is to provide food for himself and for his family. The product not consumed on his place is difficult to dispose of. Everybody else's crop matures at the same time, and most crops are perishable. Shipping costs are high, while wholesale vegetables are being handled with remarkable efficiency. The only profitable cash crops for the home gardener are specialty crops, processed or stored crops.

Many new ideas have come from the garden and later have been adopted by farmers. Thus the biodynamic idea, even though it was originally conceived for farmers, was taken over by gardeners much more rapidly. The result has been that in many instances details have been worked out in gardens, which the farmer then gradually adopts.

The home gardener today often faces two extremes when starting his venture. Few are lucky enough to get a place where the soil is in somewhat decent shape.

One source of soil problems for the home gardener lies in modern building practices. Nowadays the way to dig a cellar or level off the terrain is to use a bulldozer. This generally leads to later trouble in the garden. Quite a few of the bulldozer operators have learned their trade during the war. They generally do an excellent job in leveling off the ground by riding back and forth over it. But the requirements for building a road or an airfield are quite different from those for a garden. The ground

for an airfield has to be thoroughly compressed. Not so for a garden. People generally decide to build a house in spring or fall. First the bulldozer is called in to dig the cellar and last to fill in the land, without any consideration being given to its state of soil moisture at the time. If the soil is moist it will compact even more than when it is dry. Most bulldozers exert less pressure per square inch of tread than other tractors do. They have therefore to go over the ground again and again to compact it. Now let's ask any good gardener or farmer whether he is ever taking a roller over his ground when the soil is even slightly moist. Even if the topsoil is carefully put back on the ground, the area should afterwards be tilled *with a subsoiler*; or else the leveled terrain should be rototilled or disked before the topsoil is spread. After all, the bulldozer has created a condition similar to a hardpan, which keeps the deeper roots from reaching the layers where moisture is preserved longer.

Home gardeners facing such a problem are generally up against the need for a good compost and several years of perseverance if they want to obtain a fertile soil.

The other extreme is the garden that has been tended for many years. Gradually the mistakes start to show up. For instance, perennials are often planted too close together, so that they compete for air and root space. Sometimes they are thinned out; more often they are simply given more fertilizer, and of course each plant is given the particular fertilizer that the gardener thinks is best at the given moment. Any practices, and I mean *any*, are rationalized and artfully explained with great wisdom. Pity the poor fellow who takes over such a place and has to cope with the problems his predecessor has made him face.

The gardener, it appears, could learn something from the farmer in respect to knowing what fertilizer went where, and other things. *A farmer*, in order to survive, *has to keep records.* Farmers have learned to keep records not only of the bank balance, but of the tillage of each field, what has been planted and how much fertilizer has been applied and when. By fertilizer is meant all sorts.

The farmer generally has a map of his place. Along with the records, maps permit him to have exact information of the history and the current status of the farm. He corroborates this material with his constant observations, and can thus attain sufficient knowledge to cope, as far as may be, with his problems.

I wonder how many gardeners keep records of their gardens.

The gardener's unit is often a row or less. By superimposing one year's map (thin paper) on another's, he can see whether his crop rotation, etc., is depleting his soil, and decide what to do about it. His records on tillage, yield, fertilization, etc., will help to give him the right answers.

Let us take a look at what the farmer does with regard to crop rotation. In the Eastern U. S. A. it is usually: corn with manure; wheat or small grain; to be followed by clover or alfalfa—this of course with many variations. The basic principle is: soil depleting crop, neutral crop, soil building crop. If corn is planted year after year the yield is about one half of what it would be if corn were followed by a clover or alfalfa, or beans or peas. The loss can be made up to some extent by fertilizing, or by plowing under cover crops.

The truck grower faces a problem similar to that of the home gardener. He can, if he wants to, grow one crop year after year until the soil is exhausted, and then either switch to another crop or move elsewhere. The migration of the potato is a good example. The truck grower is learning to avoid such a situation by growing cover crops in order to supply some organic matter to the soil. Every so often a grass, or better a legume, is grown and turned under. Sufficient quantities of manures are available in only a few truck growing regions where huge numbers of cattle are fattened.

The home gardener's problem is that most of his crops are soil depleting, some neutral, while only a few are soil building. Sometimes it is possible to help this situation by increasing the home consumption of legumes such as beans, peas, and maybe even horsebeans. Ordinarily, however, about 1/2 of the garden is in soil-depleting crops, only about 1/5 in soil-building crops, with the rest in neutral crops.

If a sufficient supply of organic matter is difficult to obtain, part of the garden can be planted with a green manuring crop to be plowed under later on. A primary consideration in a garden is to grow as much as possible in a small space, and to save time when there are always a lot of other things to be done.

This leads to the problem of fertilizing. The farmer in the East applies 10 tons of manure or homemade compost per acre before planting a soil depleting crop such as corn. The gardener is in a different situation. In the first place the farmer tills his soil some 6″ deep while the gardener tries to till deeper, 8 to 10″. In other words there is almost ½ again as much soil to be fertilized in a garden as compared to the same area on a field.

The farmer reckons with a given amount to spend on fertilizer. For the U. S. A. as a whole, that is about 4-5% of his total expenses. The gardener's point of view is that he is limited in space and his labor time. It is cheaper for him to use more fertilizer in order to obtain a higher yield. Whereas the farmer uses manure or compost at a rate of 10 tons per acre, the gardener uses about 25 tons per acre and often more.

It is preferable not to apply all the compost at once. The entire garden can be covered with compost in fall, and more compost can be added to the soil depleting crops before planting; if need be, as in the case of potatoes and squash it can be put directly in the furrow or hill.

It is to be noted that there are different qualities of compost. A biodynamic compost properly treated will go farther than any old dungheap. Commercial fertilizers both organic and mineral vary in their N P K analyses, and the former vary in other ways also. The people who make their own compost either can have it analyzed, or estimate the analysis by adding up the analysis of the raw materials used, provided that the materials and the compost itself are properly handled. Losses due to leaching alone can be as high as 30% for nitrogen and phosphate, and higher for potash.

The farmer is slow to realize that he has to look at the whole fertilizer problem from still another point of view. The total quantity of fertilizers used in the U. S. A. has about trebled in the last 30 years, and the average nitrogen analysis of fertilizer has doubled. Would this be an indication that the soils have become poorer?

The U. S. Department of Agriculture has published the figure that the nitrogen lost annually in soil, due to all causes, is 22,000,000 tons. All additions from manures, fertilizers, rain and irrigation waters come to 16,000,000 tons. The total annual net loss is thus 6,000,000 tons.

The manure production of cattle alone in the U. S. A. amounts to some 6-700,000,000 tons annually. Some of it is dropped on pastures and its fertilizing effect reduced. The rest, however, should be treated by the farmer as if it were a cash income, which it is. By proper handling of his manure a farmer can reduce his fertilizer expense, and retain the organic matter content of his soil. After all, the farmer, by depleting his fertility, gradually uses up his capital and treats it as if it were income. In industry no corporation could long exist if it were run along these principles.

The gardener—long before the farmer and the truck grower did so—has watered his garden. Now they are following the gardener's example, and starting to irrigate in earnest. Nowadays irrigating seems to be the fad, where a few years ago it was some clover or other. Sometimes this practice can be costly to the grower. I have seen a walnut grove in a heavy clay soil in an irrigated district, where the operator had a certain amount of water that he could use—and he did. On this occasion he let the water flow in and went about his other business. When he returned, the grove was flooded. I saw the grove a couple of months later. The soil of the top 4″ had coagulated and formed a heavy crust which did not permit any air to penetrate through to the lower soil levels. Underneath, the soil was still friable. The man had to disk his field repeatedly, first to loosen up his soil and then to break down the lumps. At that, the experience might have been considerably more costly.

A final word of warning: the gardener supplied with city water should be wary of using it for irrigation due to the chlorine content.

CORRECTION

Dr. Pfeiffer's article "Seven Years of Soil Survey on a Biodynamic Farm", as printed in the Summer 1954 number of Bio-Dynamics, contained numerical errors in one line of Table IV, on page 7. The corrected table, in its entirety, is reproduced below:

IV. Trends and Fluctuation of pH with Good or Poor Drainage in Different Seasons in Percent of Fields

Type of Drainage	Kind of Year	Upward Trend				Downward Trend				No Change			
		% Organic Matter Level											
		1-3	3-4	4-5	5-6	1-3	3-4	4-5	5-6	1-3	3-4	4-5	5-6
poor	wet	0	50	60	0	67	50	0	0	33	0	40	100
poor	average	100	53	20	nfg	0	35	60	nfg	0	12	20	nfg
poor	dry	34	58	25	57	66	42	44	43	0	0	31	0
good	wet	40	57	nfg	nfg	60	43	nfg	nfg	0	0	nfg	nfg
good	average	50	75	50	50	50	12	32	0	0	13	18	50
good	dry	nfg	55	31	25	nfg	45	61	75	nfg	0	8	0

Also, on page 18, in the same article, in the third line from the bottom of page, the word "first" should have read "frost".

The corrected line reads as follows:

week of April after the frost, or winter moisture, had gone out

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(Adv.)

SUGAR-PILL FARMACY, MAITLAND, FLORIDA

Offers naturally fertilized oranges and grapefruit at $3.25 per bushel, plus express charges.

Fruit is in mixed sizes and unwashed, but features QUALITY.

The Farmacy is grateful for the loyal support of customers and in turn wishes to provide more fully for their needs, so we are offering some fruit from another grove recently brought into natural cultivation. By accepting this fruit, you will be giving support to the organic movement. Also, if you could help us expand our market through getting in new customers, it may make it possible for us to carry on indefinitely. Otherwise our own small grove might soon have to curtail operations.

We stand by our former guarantee, namely, if the fruit is not the equal in internal quality of any you have tasted, you pay what you consider it worth.

Fruit should be getting sweet about New Year.

H. S. Richmond

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